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TO COMPARE THE GLASGOW COMA SCALE (GCS), GLASGOW LIEGE SCALE (GLS) AND FULL-OUTLINE OF UN-RESPONSIVENESS (FOUR) SCALE TO DETERMINE THE CONSCIOUSNESS AMONG PATIENTS IN THE INTENSIVE CARE UNITS (ICUs)

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ABSTRACT

Consciousness is a state of general focus of oneself and the environment, it includes the potential to orient towards a new stimuli. Consciousness is the most sensitive indicator of neurological change. **Aim of the study:** to compare the consciousness of patients in the Intensive Care Units(ICUs) of using the Glasgow Coma Scale(GCS), Glasgow Liege Scale(GLS) and the Full Outline of Unresponsiveness(FOUR) score. **Materials and Methods:** A descriptive- comparative research design was used. A total of 21 patients were conveniently selected for the assessment of level of consciousness. 3 doctors and 14 nurses were selected from the staff, total of 40 paired observations were done by different pairs of doctors and nurses. **Results:** The internal consistency of the three scales was calculated using Cronbach's α, the internal consistency of GCS was 0.76, 0.77 for GLS and 0.66 for FOUR score. **Conclusion:** The results could not be concluded with the availability of very limited number of patients. Majority of the raters agreed that GLS and FOUR score were reliable, reproducible, give more clinical information and can be used as an alternative to GCS. However, there is no significant difference in the opinion of the raters regarding the scales.

KEYWORDS: Glasgow Coma Scale, GCS, Glasgow Liege Scale, GLS, Full-Outline of Unresponsiveness Score, FOUR Score, Consciousness.

1. INTRODUCTION

Consciousness is a state of general awareness of oneself and the environment and includes the ability to be oriented to time, place, and person. Consciousness is multifaceted and divided into two components:

- **Alertness or wakefulness:** the appearance of wakefulness; reflects activity of the reticular activating system
- **Awareness or cognition:** content of cognitive mental functions; reflects cerebral cortex activity

Glasgow Coma Scale(GCS) measures an individual's consciousness according the three components i.e.- Eye Response, Verbal Response and Motor Response. the Glasgow Liege Scale(GLS) was developed in Liege, Belgium in the year 1982. It combined the Glasgow Coma Scale with a quantified analysis of five brainstem reflexes: fronto-orbicular, vertical oculo-cephalic, pupillary, horizontal oculo-cephalic and oculo-cardiac. Wijdicks et al. evolved a brand new coma scale, Full-Outline of Unresponsiveness (FOUR) rating, considering the restrictions of the GCS. Verbal reaction isn't always an issue of the FOUR rating. Brainstem reflexes and pattern of respiration, which may be used in the assessment of sufferers with reduced LOC and not used in GCS, had been integrated into the FOUR score. The FOUR score, opposite to the GLS/GCS, avoids assessing verbal feature. Certainly, in the extreme care setting(ICU), maximum patients are intubated or tracheotomised which makes correct assessment of verbal responses tough. It includes four components: eyes and motor responses, brainstem reflexes, and respiratory pattern. GCS is an important tool in the assessment of patients. But, there is no doubt that the FOUR provides an adequate initial assessment of patients with disturbed level of consciousness and it can be easily used by inexperienced nurses.

1.1 Objective

- To compare the internal consistency of Glasgow Coma Scale(GCS), Glasgow Liege Scale(GLS) and Full Outline of UnResponsiveness (FOUR) Scale.
- To compare the inter-rater reliability of Glasgow Coma Scale(GCS), Glasgow Liege Scale(GLS) and Full Outline of UnResponsiveness (FOUR) Scale.
- To determine the relationship of score of consciousness of patients by Glasgow Coma Scale(GCS), Glasgow Liege Scale(GLS) and Full Outline of UnResponsiveness (FOUR) Scale.
- To compare the acceptability of Glasgow Coma Scale(GCS), Glasgow Liege Scale(GLS) and Full Outline of UnResponsiveness (FOUR) Scale among doctors and staff nurses.

2. MATERIALS AND METHODS

2.1 Research approach- Quantitative Research Approach
2.2 Research design- Descriptive-Comparative Research Design
2.3 Sampling Technique-Non-Probability Sampling I.E.-Convenience Sampling Technique
2.4 Sample- Doctors & Nurses
2.5 Tool- Demographic Data, Glasgow Coma Scale, Glasgow Liege Scale, Full Outline of Unresponsiveness(FOUR), Rater's Opinionnaire
2.6 Data Collection- Structured Rating Scales
2.7 Data Analysis- Inferential and descriptive analysis.

3. RESULTS

3.1 Section A: Description of sample characteristics

Finding revealed that All (100%) of the doctors belonged to the age group of 31-40 years, while nurses belonged to the age group of 20-30 years. All (100%) of the doctors were either pursuing or have completed their MD. 78.57% of the nurses had GNM as their professional qualification while 21.42% of the nurses had B.Sc. Nursing as their professional qualification. About 1/3rd of the doctors (33.3%) possessed a total clinical experience of 0-1 years, 1-2 years and 2-3 years. Majority (57.1%) of the nurses possessed a total clinical experience of 0-1 years, while only 21.4%, 14.2% and 7.1% of the nurses had a total clinical experience of 1-2 years, 2-3 years and more than 3 years respectively. About 1/3rd of the doctors (33.3%) possessed a total clinical experience in the ICU of 0-1 years, 1-2 years and 2-3 years. Majority (57.1%) of the nurses possessed a total clinical experience in the ICU of 0-1 years, while only 21.4% of the nurses had a clinical experience in the ICU of either 1-2 years or 2-3 years. All (100%) of the doctors and nurses had only used the Glasgow Coma Scale(GCS) to determine level of consciousness.

Table 1
Frequency and percentage distribution of raters according to sample characteristics

N=17

S.No.	Sample Characteristics	Doctors (n=3)		Nurses (n=14)	
		f	%	f	%
1	**Age (years)**				
1.1	20-30			14	100%
1.2	31-40	3	100%		
2	**Professional Qualification**				
2.1	GNM			11	78.57%
2.2	B.Sc Nursing			3	21.42%
2.3	M.D.	3	100%		
3	**Total Clinical Experience (years)**				
3.1	0-1	1	33.3%	8	57.1%
3.2	1-2	1	33.3%	3	21.4%
3.3	2-3	1	33.3%	2	14.2%
3.4	>3			1	7.1%
4	**Total Clinical Experience In ICU (years)**				
4.1	0-1	1	33.3%	8	57.1%
4.2	1-2	1	33.3%	3	21.4%
4.2	2-3	1	33.3%	3	21.4%
5	**Ever used any scale for assessing Level of Consciousness**				
5.1	GCS	3	100%	14	100%

Section B

Table-2

Inter-Rater reliability of Glasgow Coma Scale (GCS), Glasgow Liege Scale (GLS) and Full-Outline of Unresponsiveness (FOUR) Scale among doctors and staff nurses.

N=40

		SCALES		
Pair	n	GCS	GLS	FOUR
Nurse-Nurse	18	0.72	0.66	0.71
Nurse-Doctor	12	0.69	0.70	0.64
Doctor-Doctor	10	0.87	0.76	0.83

Table 2.shows the Inter-Rater Reliability of the Glasgow Coma Scale(GCS), Glasgow Liege Scale(GLS) and Full-Outline of UnResponsiveness(FOUR) scales as measured by Cohen's Kappa. Among the Nurse-Nurse pair, highest value of Kappa( ) was seen in GCS which was 0.72, almost similar (0.71) value was seen in FOUR Scale, while the lowest value of 0.66 was seen for GLS. Among the Nurse-Doctor pair, highest value of Kappa( ) was seen in GLS which was 0.70, almost similar value (0.69) was seen in GCS Scale, while the lowest value was seen for FOUR Scale which was 0.64.Among the Doctor-Doctor pair, highest value of Kappa( ) was seen in GCS, almost similar value of 0.83 was seen in FOUR Scale, while the lowest value was seen for GLS which was 0.76.The highest value of kappa( ) for GCS (0.87) was seen among the Doctor- Doctor pair, while the kappa( ) value was 0.72 and 0.69 among the Nurse-Nurse and Nurse-Doctor pair respectively. For GLS, the kappa( ) value was highest (0.76) among the Doctor-Doctor pair, for Nurse-Nurse pair kappa( ) was 0.66, while 0.70 for Nurse-Doctor pair. For FOUR scale the kappa( ) values were highest among Doctor-Doctor pair i.e.- 0.83, while in Nurse-Nurse pair it was 0.71 and lowest (0.64) among Nurse- Doctor pairs.

Table-3

Inter-Rater reliability of components of Glasgow Coma Scale(GCS) among Nurse-Nurse Pair, Doctor-Nurse Pair and Doctor-Doctor Pair

N=40

		COMPONENTS OF GCS			
PAIR	N	Eye Response Score	Verbal Response Score	Motor Response Score	Total Score
Nurse-Nurse	18	1.0	0.62	1.0	0.72
Nurse-Doctor	12	1.0	0.88	0.72	0.69
Doctor-Doctor	10	1.0	1.0	0.83	0.87
Overall	40	1.0	0.80	0.85	0.75

Table 3 From the above findings, it can be concluded that among the Nurse-Doctor pair, of all the components of GCS the Motor Response component has the least inter-rater reliability score of 0.72, which further tells that the understanding of the motor response is different among the doctors and staff nurses.

Table-4

Inter-Rater reliability of components of Glasgow Liege Scale(GLS) among Nurse-Nurse Pair, Doctor-Nurse Pair and Doctor-Doctor Pair

N=40

		COMPONENTS OF GLS				
PAIR	n	Eye Response Score	Verbal Response Score	Motor Response Score	Brainstem-Reflexes Score	Total Score
Nurse-Nurse	18	1.0	0.71	0.83	0.46	0.66
Nurse-Doctor	12	1.0	0.88	0.85	0.63	0.70
Doctor-Doctor	10	1.0	1.0	0.83	0.81	0.76
Overall	40	1.0	0.84	0.85	0.61	0.71

Table 4: Comparing the overall kappa( ) values for each component of the GLS, eye response has the highest value of 1.0, while for the verbal response and motor response scores the value is 0.84 and 0.85 respectively. And lowest (0.61) kappa( ) value was seen for the brain-stem reflexes component.

Table-5

Inter-Rater reliability of components of Full-Outline Of Unresponsiveness(FOUR) scale among Nurse-Nurse Pair, Doctor-Nurse Pair and Doctor-Doctor Pair.

N=40

		COMPONENTS OF FOUR SCALE				
RATER PAIR	n	Eye Response Score	Motor Response Score	Brainstem -Reflexes	Respiration Score	Total Score
Nurse-Nurse	18	0.91	0.89	0.90	0.89	0.71
Nurse- Doctor	12	1.0	0.86	0.70	1.0	0.64
Doctor-Doctor	10	1.0	1.0	0.83	1.0	0.83
Overall	40	0.96	0.90	0.82	0.94	0.72

Table 5 : From the above findings it can be concluded that the least value of inter-rater reliability was seen among the Nurse-Doctor pair in the brainstem reflexes component. It can be deduced that the understanding and interpretation of brainstem reflexes is different among the doctors and nurses.

Table-6

Correlation of consciousness score by Glasgow Coma Scale(GCS), Glasgow Liege Scale(GLS) and Full-Outline of Unresponsiveness(FOUR) Scale

N=80

	FOUR	GCS	GLS	'p' value
GCS	0.77	-	-	0.023*
GLS	-	0.92	-	0.01*
FOUR	-	-	0.78	0.013*

*** Significant(p<0.05)**

Table 6 shows the highly positive and significant correlation of =0.92 between the GCS and GLS scale was seen. While a positive and significant relationship of =0.77 among the GCS and FOUR scale and =0.78 among the GLS and FOUR scale was seen.

Table-7

Rater's Opinion on acceptability of the Glasgow Coma Scale(GCS), Glasgow Liege Scale(GLS) and Full Outline of Unresponsiveness(FOUR) Scale

N=17

S.No.	Statement	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
	GLASGOW COMA SCALE (GCS)					
1	GCS is reliable	8(47%)	9(53%)			
2	GCS is easy to use	11(65%)	6(35%)			
3	GCS is reproducible	7(41%)	9(53%)		1(6%)	
4	GCS gives more clinical information.	3(18%)	14(82%)			
5	GCS takes less time to perform	2(12%)	15(88%)			
6	GCS is easy to memorise	4(24%)	9(53%)		4(24%)	
	GLASGOW LIEGE SCALE (GLS)					
1	GLS is reliable	6(35%)	11(65%)			
2	GLS is easy to use	1(6%)	8(47%)	3(18%)	5(29%)	
3	GLS is reproducible	6(35%)	10(59%)	1(6%)		
4	GLS gives more clinical information	3(18%)	14(82%)			
5	GLS takes less time to perform	1(6%)	10(59%)		6(35%)	
6	GLS can be used as an alternative to GCS		15(88%)	2(12%)		

S.No.	Statement	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
FULL-OUTLINE OF UNRESPONSIVENESS (FOUR) SCORE						
1	FOUR Score is reliable	1(6%)	15(88%)	1(6%)		
2	FOUR Score is easy to use	3(18%)	12(70%)		2(12%)	
3	FOUR Score is reproducible	3(18%)	10(59%)	3(18%)	1(6%)	
4	FOUR Score gives more clinical information	2(12%)	15(88%)			
5	FOUR Score takes less time to perform	3(18%)	12(70%)	1(6%)	1(6%)	
6	FOUR Score can be used as an alternative to GCS	2(12%)	14(82%)	1(6%)		

Table 7 shows the overall the raters either agreed or strongly agreed to the statements that the Glasgow Liege Scale(GLS) and Full Outline of Unresponsiveness(FOUR) Scale are reliable, easy to use, reproducible gives more clinical information and can be used as alternatives to Glasgow Coma Scale(GCS). However, more raters disagreed that GLS is easy and takes less time to perform, while only few raters opined the same for FOUR Scale.

Table-8
Rater's Acceptability Scores of the Glasgow Coma Scale(GCS), Glasgow Liege Scale(GLS) and Full Outline of Unresponsiveness(FOUR) Scale

STATEMENT	GCS	GLS	FOUR
Scale is reliable	76	74	68
Scale is easy to use	79	56	67
Scale is reproducible	73	73	66
Scale gives more clinical information	71	71	70
Scale takes less time to perform	70	57	68
Scale can be used as an alternative to GCS	-	66	69

Table 8 it reveals that According to the rater's responses, FOUR scale can be used as a better alternative than GLS to the existing GCS.

Discussion
The purpose of this quantitative study was to compare the Glasgow Coma Scale (GCS), Glasgow Liege Scale (GLS) and Full-outline of Un-responsiveness (FOUR) scale to determine the consciousness among patients in the intensive care units (ICUs).

Findings related to the demographic profile of the patients and raters

Majority of the doctors were either pursuing or have completed their MD (3)100%. 78.57% of the nurses had GNM as their professional qualification while 21.42% of the nurses had B.Sc Nursing as their professional qualification. Majority of the doctors (66.6%) possessed a total clinical experience of less than 2 years, while only 33.3% possessed a clinical experience of more than 2 years. Majority (78.57%) of the nurses possessed a total clinical experience of 0-2 years, while only 14.28% and 7.14% of the nurses had a total clinical experience of 2-3 years and 3-4 years respectively. Majority of the doctors (66.6%) possessed a total clinical experience in the ICU of less than 2 years, while only 33.3% doctors possessed a total clinical experience in the ICU of more than 2 years. Majority of the nurses (85.71%) possessed a total clinical experience in the ICU of 0-2 years, while only 14.28% had a total clinical experience in the ICU of 2-3 years. All (100%) of the doctors and nurses have only used the Glasgow Coma Scale(GCS) to determine level of consciousness.

Most (33.3%) of the patients belonged to the age group of 31-40 years. 28.57% of the patients belonged to the age group of 41-50 years while 19.04% of the patients were either between 18-30 years of age or more than 50 years. Majority (80.95%) of the patients were males while 19.04% were females. All (100%) of the patients were admitted with neurological disorders. On examination 76.19% of the patients were found to be drowsy, while 23.80% were stuporous or confused.

Findings related to the comparison of Internal Consistency of Glasgow Coma Scale(GCS), Glasgow Liege Scale(GLS) and Full-Outline Of Unresponsiveness(FOUR) Scale.

Highest α value of 0.77 was seen in Glasgow Liege Scale(GLS), while α values for Glasgow Coma Scale(GCS) and Full-Outline of UnResponsiveness(FOUR) Scale are 0.76 and 0.66 respectively.

Findings related to the comparison of Inter-Rater Reliability of Glasgow Coma Scale(GCS), Glasgow Liege Scale(GLS) and Full-Outline Of Unresponsiveness(FOUR) Scale among different rater pairs and among different components of each scale.

The highest value of kappa( ) for GCS was seen among the Doctor-Doctor pair, while the kappa( ) value was 0.72 and 0.69 among the Nurse-Nurse and Nurse-Doctor pair respectively. For GLS the kappa( ) value was highest (0.76) among theDoctor-Doctor pair, for Nurse-Nurse pair kappa( ) was 0.66, while 0.70 for Nurse- Doctor pair. For FOUR scale the kappa( ) values were highest among Doctor- Doctor pair i.e.- 0.83, while in Nurse-Nurse pair it was 0.71 and lowest (0.64) among Nurse-Doctor pairs.

Comparing the overall kappa( ) values for each component of the GCS, eye response has the highest value of 1.0, while for the verbal response and motor response scores the value is 0.80 and 0.85 respectively.

The overall kappa( ) values for each component of the GLS, eye response has the highest value of 1.0, while for the verbal response and motor response scores the value is 0.84 and 0.85 respectively. And lowest (0.61) kappa( ) value was seen for the brain-stem reflexes component.

The overall kappa( ) values for each component of the FOUR scale, eye response has the highest value of 0.96, while for the motor response the kappa value was 0.90, for the brainstem reflexes it was 0.82 and 0.94 for the respiration score.

Findings related to the correlation of Consciousness Score by Glasgow Coma Scale(GCS), Glasgow Liege Scale(GLS) And Full-Outline Of Unresponsiveness(FOUR) Scale.

Spearman's Rho( ) was used to analyze the correlation among the GCS, GLS and FOUR scales for 80 observations. A highly positive correlation of =0.92 between the GCS and GLS scale was seen. While a positive relationship of =0.77 among the GCS and FOUR scale and =0.78 among the GLS and FOUR scale was seen.

Findings related to the comparison of rater's opinion regarding the use of Glasgow Coma Scale(GCS), Glasgow Liege Scale(GLS) And Full-Outline Of Unresponsiveness(FOUR) Scale.

Comparing the opinion of the raters on the GCS,GLS and FOUR scale; most favorable replies regarding ease of use, reliability, giving clinical information and taking less time to perform were given to Glasgow Coma Scale(GCS), followed by

Full-Outline of UnResponsiveness(FOUR) Scale and Glasgow Liege Scale(GLS). The raters felt that FOUR scale could be used as an alternative to GCS.

4. CONCLUSION
The following conclusions can be drawn from the study:-

- The internal consistency of Glasgow Liege Scale(GLS) was the highest when compared to the other scales, followed by Glasgow Coma Scale(GCS) and Full Outline of Unresponsiveness(FOUR) Scale. Meaning that the FOUR scale has the least internal consistency in measuring the same construct.
- The inter-rater reliability among the Nurse-Nurse pair was the highest for the Glasgow Coma Scale(GCS), followed by the FOUR scale and the GLS.
- The inter-rater reliability among the Nurse-Doctor pair was the highest for the Glasgow Liege Scale(GLS), followed by GCS and FOUR scale.
- Among the Doctor-Doctor pair, the inter-rater reliability was the highest for the Glasgow Coma Scale(GCS), followed by the FOUR scale and the GLS.
- Comparing the pair in terms of their inter-rater reliability, the Doctor-Doctor pair had the highest reliability for any kind of scale.
- Comparing the inter-rater reliability of the components of Glasgow Coma Scale(GCS) it was seen that the eye response had the best reliability among all the pairs. followed by the motor response. The verbal response had the least reliability among all pairs. Also the Nurse-Nurse pair had the least reliability for the verbal response component.
- Findings also suggest that of all the components of Glasgow Liege

Scale(GLS), the brainstem reflexes component of the GLS has the least reliability when measured by any pair of raters, i.e.- Nurse-Nurse, Nurse- Doctor and Doctor-Doctor have a different interpretation of the brainstem reflexes.

- For the Full Outline of Unresponsiveness(FOUR) Scale the least value of inter-rater reliability was seen among the Nurse-Doctor pair in the brainstem reflexes component. Inter-rater reliability was the best for the eye response and respiration score.
- Comparing the opinion, the raters either agreed or strongly agreed to the statements that the Glasgow Liege Scale(GLS) and Full Outline of Unresponsiveness(FOUR) Scale are reliable, easy to use, reproducible gives more clinical information and can be used as alternatives to Glasgow Coma Scale(GCS). However, more raters disagreed that GLS is easy and takes less time to perform, while only few raters opined the same for FOUR Scale.

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